Matrix Multiplication

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Matrix Multiplication

- 행렬 곱
- Inner Product, Dot Product

$$
\begin{aligned}
AB &= \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \\
&= \begin{bmatrix} 1\times 1+2\times 3+3\times 5 & 1\times 2+2\times 4+3\times 6 \\ 4\times 1+5\times 3+6\times 5 & 4\times 2+5\times 4+6\times 6 \end{bmatrix} \\
&= \begin{bmatrix} 1+6+15 & 2+8+18 \\ 4+15+30 & 8+20+36 \end{bmatrix} = \begin{bmatrix} 22 & 28 \\ 49 & 64 \end{bmatrix}
\end{aligned}
$$

$$
A \in \mathbb{R}^{2\times 3}, B \in \mathbb{R}^{3\times 2} \text{ and } AB \in \mathbb{R}^{2\times 2}.
$$

$$
\downarrow
$$

$$
|A| = (2,3), |B| = (3,2) \text{ and } |AB| = (2,2).
$$

Vector Matrix Multiplication

- 벡터와 행렬의 곱셈

$$
\begin{aligned}
v^\intercal M &= \begin{bmatrix} 1 & 2 & 3 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \\
&= \begin{bmatrix} 1 \times 1 + 2 \times 3 + 3 \times 5 & 1 \times 2 + 2 \times 4 + 3 \times 6 \end{bmatrix} \\
&= \begin{bmatrix} 1 + 6 + 15 & 2 + 8 + 18 \end{bmatrix} = \begin{bmatrix} 22 & 28 \end{bmatrix}
\end{aligned}
$$

$$
v \in \mathbb{R}^3, v^\intercal \in \mathbb{R}^{1 \times 3} \text{ and } M \in \mathbb{R}^{3 \times 2}.
$$

$$
\downarrow
$$

$$
|v^\intercal| = (1, 3), |M| = (3, 2) \text{ and } |v^\intercal M| = (1, 2).
$$

Vector Matrix Multiplication

- 벡터와 행렬의 곱셈

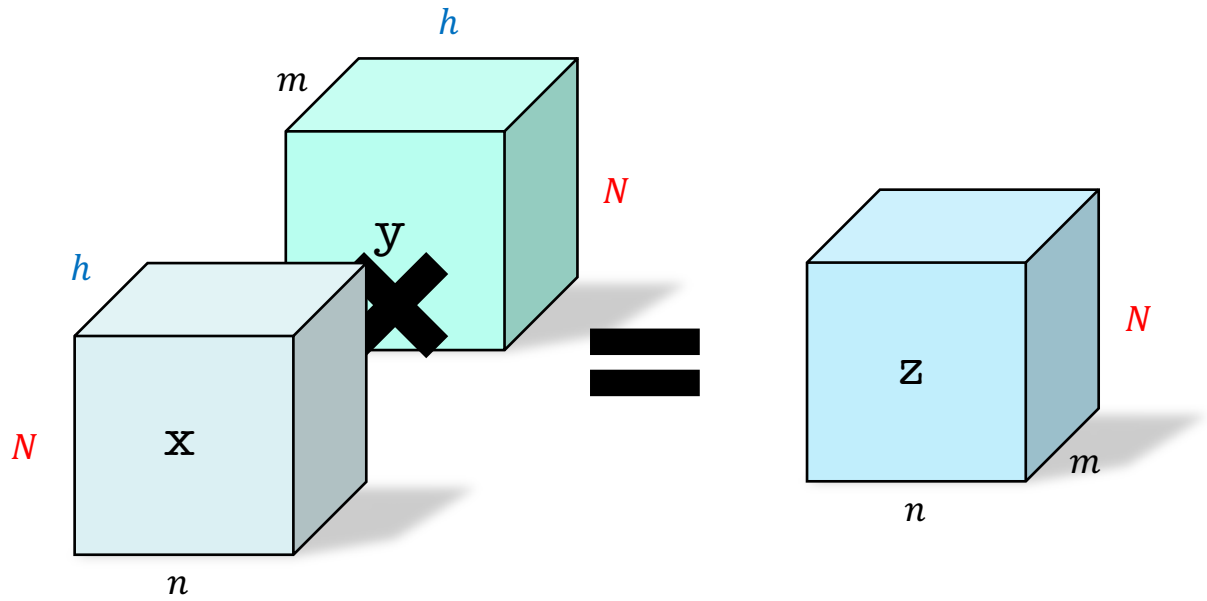
$$Mv = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix} \times \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$$= \begin{bmatrix} 1 \times 1 + 2 \times 2 \\ 3 \times 1 + 4 \times 2 \\ 5 \times 1 + 6 \times 2 \end{bmatrix} = \begin{bmatrix} 1 + 4 \\ 3 + 8 \\ 5 + 12 \end{bmatrix} = \begin{bmatrix} 5 \\ 11 \\ 17 \end{bmatrix}$$

$$|M| = (3, 2), |v| = (2,) = (2, 1) \text{ and } |Mv| = (3, 1).$$

Batch Matrix Multiplication (BMM)

- 같은 갯수의 행렬 쌍들에 대해서 병렬로 행렬 곱 실행



z = torch.bmm(x, y)

$$(N, n, h) \times (N, h, m) = (N, n, m)$$

x y z